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MEAT TEMPERING PRACTICES AND ANALYSIS OF MEAT TEMPERING SYSTEMS AT ARMY INSTALLATIONS

by
Edward R. Baush
Maj Paul L. Caron
CW2 Robert L. Stephan
Justin M. Tuomy

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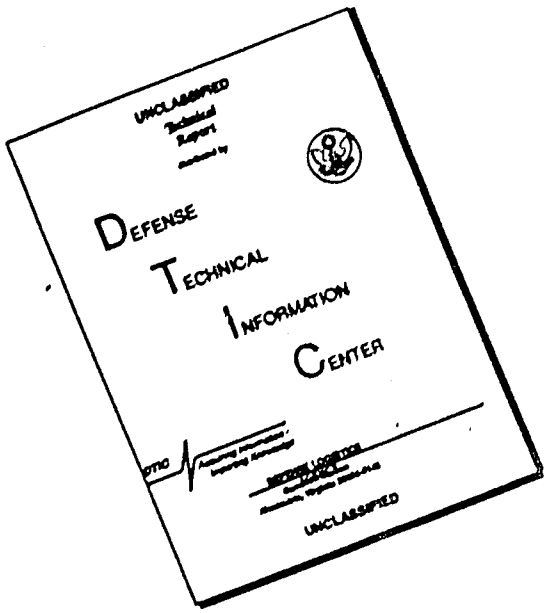

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A field study was conducted to determine the scope and reasons for the practice of uncontrolled temperature tempering of frozen meats; to evaluate its public health significance; and to develop recommendations to reduce or eliminate this practice within dining facilities. It was determined that uncontrolled temperature tempering of meat is frequently practiced in Army dining facilities. A potential health hazard was found to exist when uncontrolled temperature tempering of meat is practiced; however, a history of food borne disease attributable to this practice could not be documented. An analysis was made of

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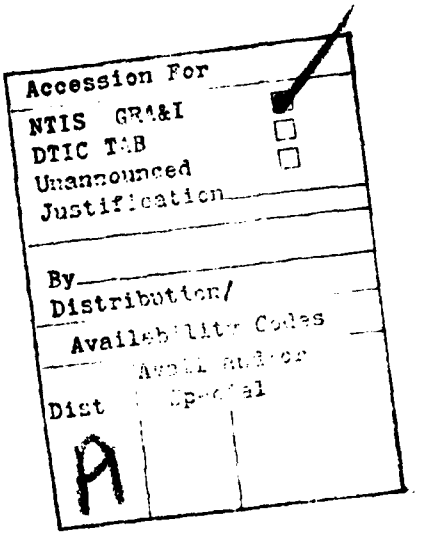
alternative systems and procedures that could be employed to temper frozen meats effectively and safely. Recommendations are made for studies to determine the most effective system and procedures to temper meats under current Troop Issue Subsistence Activity and dining facility concepts of operation. The public health aspects of improper meat tempering practices are discussed and meat items and quantities requiring tempering per day to feed various troop strengths are tabulated.

PREFACE

Frozen meat is frequently tempered in the Army dining facility by means that violate sanitary food handling methods as stated in Army regulations and present a potential health hazard. In addition, improper tempering can be the cause of damage to meat that results in loss of quality, nutritive value, and yield. The present Troop Issue Support Activity and dining facility concepts of operation do not address meat tempering problems or requirements. To address these problems, a field study was conducted to evaluate current practices and an analysis was made of alternatives for tempering meat. This effort was undertaken under Program Element No. 72801219000, Cost Code 03146921000.



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MEAT TEMPERING PRACTICES AND ANALYSES OF MEAT TEMPERING SYSTEMS AT ARMY INSTALLATIONS

I. INTRODUCTION

A new concept of operations for the cold storage facilities of Troop Issue Subsistence Activities (TISA) is being developed by the Troop Support Agency (TSA). Currently, neither the TISA nor dining facility concepts of operation address the necessity to temper or thaw frozen meats to facilitate proper handling prior to preparation in the dining facility.

Most of the TISA cold storage facilities are old and inadequately equipped to provide tempered meats to dining facilities. Many dining facilities do not have sufficient refrigeration space to properly temper frozen meats. Frozen meats issued to dining facilities are frequently allowed to be tempered at ambient(room) temperatures under uncontrolled conditions, usually in sinks and on top of the work tables. This practice violates sanitary food handling methods as stated in AR 40-5. [1] The potential health hazard of this practice is recognized and requires the attention of the responsible activities. In addition, improper tempering of meat is a detrimental process that subjects the product to other deteriorative changes. It has been reported that during the tempering process the product is subject to serious potential sources of damage: growth of microorganisms, concentrated tissue liquids, recrystallization, and mechanical damage to cells. [2] Other research has shown that these deteriorative changes create drip loss (loss of tissue fluids) that results in a decrease in quality, nutritive value, and yield. [3]

Meat quality was found to be affected because of loss of flavor, color changes, and surface drying of the tissue. Drip loss for boxed beef weighing 60 lb was reported to be 5.0%. The drip fluid was found to have a protein content of 10.0%, which amounts to a protein loss of 0.3 lb per 60 lb of tempered meat. Unfortunately, tempering of frozen meat is frequently conducted by individuals unaware or unconcerned with the effects of improper methods on sanitation, public health, quality, and cost.

To address this problem, it is considered essential that a field study of meat tempering practices and alternatives be conducted in conjunction with TSA efforts to develop concept of operations for the modernization of Troop Issue Subsistence Activities.

1 AR 40-5, 1974. Medical Services - Health and Environment, Headquarters, Department of the Army, Washington, D.C.

2 O. Fennema and W.D. Powrie, 1964. Fundamentals of Low Temperature Food Preservation. Advances in Food Research. 13,219-347.

3 A. Bezanson, 1975. Thawing and Tempering Frozen Meat. Proceedings of Meat Industry Research Conference, American Meat Institute Foundation, 51-62.

There is no standard definition for the word "tempering" in the meat industry, and the words "tempering" and "thawing" are frequently used interchangeably. This is because there are many different criteria for tempering, each of which may correspond to a different degree of thawing, i.e., 30% thawed, 50% thawed, etc., depending on need. [4] When used in this report, the term "tempered" may reflect either partially or completely thawed meat depending on the situation.

Meat can be tempered by any one of several methods. This study is restricted to those systems operating within the constraints of AR 40-5 and that indicate no obvious operating limitations for their intended use. These systems are controlled temperature (air or water) and microwave energy sources (915 and 2450 MHz).

Currently, controlled temperature systems (air and water) are recommended for tempering meats in the Army dining facility. Tempering systems have not been used in the TISA activities at Army installations. Prior to this study, a visit was made to Keesler AFB, Biloxi, Mississippi, to observe a central food preparation operation and determine the effectiveness of a controlled air temperature 40-45^{o}F (4.4-7.2^{o}C) meat tempering system being used to prepare meats for issue to dining facilities. The effectiveness and success of this Air Force system can be attributed to the following:

a. Tempering is performed at a central preparation kitchen.

b. Meats are removed from cartons and placed on racks prior to tempering.

c. Standard installation menu is used.

d. Population served is stable.

e. Number of dining facilities is limited.

Similar conditions were not found to exist in any of the Army installations surveyed and covered in this report.

Microwave energy for tempering frozen meats has received increased attention in the last several years and is being applied successfully in industrial operations. Systems for institutional or home use have been developed based on 2450 MHz, a frequency corresponding to a low penetrating wavelength. This frequency is used because cooking or heating and not tempering is the primary intended use. Large industrial systems, which are designed only to temper bulk units of meat (50-60 lb) operate at a lower frequency of 915 MHz, which has greater penetrating power. Military interest in microwave tempering of meat began when plans

[4] Ibid.

were developed to implement a central food preparation approach to garrison food service, where large quantities of frozen meat would require tempering. NARADCOM was tasked with providing support to TSA in this area. As part of this support, a microwave tempering unit was tested to determine its effectiveness in the proposed system. It was determined that cases of frozen meat obtained from the supply system could be successfully tempered, and that microwave tempering could be used advantageously by the Armed Forces.[5]

When meat tempering time is reduced, the opportunity for product damage to occur is lessened.[6] The transfer of heat energy by conduction or convection in systems used to temper meat is slow. Microwave energy permits a system that achieves rapid tempering by its ability to instantly transfer electromagnetic energy to, and generate heat energy within, the meat. The short time required for microwave energy to temper meat (minutes vs hours for other systems) may be the most effective system to minimize or eliminate the adverse effect of improper meat tempering on sanitation, public health, quality, and cost.

The objectives of this study were:

a. To survey facilities and determine the scope and reasons for uncontrolled tempering of meat at ambient temperatures in dining facilities.

b. To determine meat items and quantities requiring tempering prior to use in dining facilities.

c. To make a subjective analysis and predict what benefits and/or problems would result if alternate systems (controlled temperature or microwave energy) were used to temper frozen meats to be handled under current TISA and dining facility concepts of operation.

d. Evaluate public health aspects of meat tempering.

e. To eliminate improper meat tempering practices.

II. PROCEDURE FOR SURVEY OF FACILITIES

A survey of dining and TISA facilities was conducted at five installations selected from information that described the military mission and number and size of dining facilities at each location.

[5] J. Swift and J.M. Tuomy. Evaluation of Microwave Tempering of Meat for Use in Central Food Preparation Facilities. Technical Report TR 76-32 - FEL. US Army Natick Research and Development Command, Natick, MA. AD# A-027788

[6] Op. cit. O. Fennema

To achieve a representative cross-section of the various types of installations, the following were selected:

a. Fort Sill, Lawton, Oklahoma
   Army Field Artillery Center - Basic training and Advanced Infantry Training

b. Fort Devens, Ayer, Massachusetts
   Military Intelligence School
   Special Forces
   Various Mobile Field Units

c. Fort Ord, Monterey, California
   Seventh Infantry Division
   Combat Development Experiment Command
   Organizational Training Command
   Defense Language Institute (located at Presidio of Monterey)

d. Fort Gordon, Augusta, Georgia
   Signal Corps Center - Basic Training and Advanced Infantry Training
   Military Police Training

e. Fort Bragg, Fayetteville, North Carolina
   82nd Airborne Division
   18th Airborne Corps Headquarters
   Institute for Military Assistance
   Special Forces

Before surveying each installation, a meeting was arranged with the Post Food Service Officer and Troop Issue Subsistence Officer to discuss the reason for the study, to obtain an overview of the food service operation and to determine the number, age, function, and type of dining facilities in operation. The TISA Facility and a representative selection of dining areas were then surveyed. When possible, discussions concerning the survey were held with Post Veterinarians and Preventive Medicine Officers to obtain their views on meat tempering systems and potential hazards and/or problems experienced under current conditions. A survey of each TISA was made to determine the physical condition of the facility and the operating procedures followed in handling and issuing rations. Surveys of dining facilities encompassed a discussion with the dining hall manager concerning his procedures for handling frozen meats requiring tempering, problems encountered in tempering, and his method to surmount the problems. In addition, the total cubic feet of refrigeration space and average number of meals served per day were determined to establish a basic unit (cubic feet of refrigeration per meal per day) to compare the basic capability of each dining facility to temper frozen meat.

III. RESULTS AND DISCUSSION

A. Troop Issue Support Activity Facilities: With one exception (Fort Gordon), all cold storage facilities are housed in

converted meat-cutting plants that exhibited evidence of physical deterioration. Depending on the installation, the TISA work force is comprised of military personnel or a mixture of military and civilian personnel. Where military personnel are used, they are frequently called to the field, leaving the TISA understaffed. The frequent turnover of military help creates a flow of inexperienced labor that results in a loss of efficiency and operational control of rations. Some TISA facilities operate on a Monday, Wednesday, Friday issue cycle and others issue rations daily. With the exception of ready to cook (RTC) turkeys for holiday use and certain canned items, all meat items are issued in the frozen state. Some TISA facilities issued rations exclusively for pickup by individual dining facilities, others issued rations in the same manner and also operated as maxi-marts, and some operated only as maxi-marts. At one maxi-mart TISA, some dining facilities picked up rations less than daily, some daily, and others more than once a day, indicating a wide diversity in planning and scheduling by individual dining hall managers. Both refrigerated and non-refrigerated vehicles were in use for the pickup and delivery of rations. A standard installation menu is not used nor required at any of the installations surveyed. Under the Army Ration Credit System (ARCS), each dining hall manager establishes the menu and rations needed for his facility. The TISA is required to handle a multiplicity of ration items as a result of the diversity of menus being served on a day-to-day basis. At some installations the TISA does not receive any advance schedule of needs from the users. Non-standard installation menus, menu diversity, and lack of requirements input to the TISA tend to complicate and diminish operating effectiveness. The age, overall physical condition, and lack of proper utilities would make it extremely difficult to conduct meat tempering studies under sanitary conditions at these locations.

The TISA facility at Fort Gordon is different from those surveyed at other installations. It is a relatively new building (1970 construction) and of modern design and features. The building has a 4718 sq ft holding freezer, 4 chill rooms (1930 sq ft, 1863 sq ft, 1729 sq ft, and 1492 sq ft), 2794 sq ft of processing area, and a 2151 sq ft ration breakdown and assembly area. There is additional covered dock space and wash and auxiliary rooms. This is the only TISA facility of the installations surveyed that has the sanitation, utilities, and space requirements in which a study of meat tempering systems could be properly conducted.

B. Dining Facilities: The dining facilities surveyed varied in age, design, construction, and food service equipment. The function of each varied according to the mission of troops assigned, e.g., reception of new recruits, transient personnel, basic training, fixed garrison, or mobile field troops. Some dining facilities prepare meals and deliver them in insulated containers for field feeding. Others, such as mobile field troops dining facilities, prepare meals in the field and were found to have special logistics problems related to delivery, storage, and preparation of perishable rations during field exercises. Use of tempered meat for this purpose

could be a source of concern, especially in southern areas, because of use of non-refrigerated trucks and limited field refrigeration. Under current conditions, frozen meats are desired by mobile field units to help keep other perishables cold and to prevent premature spoilage of the meat. Use of tempered meats under this particular situation could result in increased perishability, product loss, and the potential for creation of serious sanitation and health hazards (see Section VI). Resource constraints prevented an evaluation of current field feeding problems related to distribution, lack of adequate refrigeration, handling, and preparation of meats, and/or the actual effect of utilizing tempered meats under existing field conditions.

Within the dining facilities there is a wide diversity in handling frozen meat prior to use, because of variations in refrigeration space, time constraints, and individual skill, experience, knowledge, and planning expertise of dining facility managers. The survey revealed that tempering of frozen meats at ambient temperatures in dining facilities frequently occurs. The reasons determined for this practice are as follows:

1. Refrigeration Constraints

Refrigeration space available per meal served was calculated to demonstrate the wide variation that exists between dining facilities and to compare the ability of each to temper frozen meats. Ambient temperature tempering of frozen meats was, in general, found to be most prevalent in dining facilities having the least volume of refrigeration space per meal served. The survey data indicates that when 1.5 cu ft of refrigeration space per meal per day is available, the problem is minimized. The magnitude of the problem increases as refrigeration space per meal decreases below 1.5 cu ft. (See Table 1). The problem occurs most frequently with ground meats in bulk, cut-up chicken, and RTC poultry because the bulk and/or configuration of the package unit impedes the rate of tempering. Time influences the tempering of frozen meat and is a factor that can only be partially controlled by adequate refrigeration space. Inadequate refrigeration space is considered to be the major reason for the practice of ambient temperature tempering frozen meats.

2. Dining Facility Management

A diversity was found to exist in the individual management skills, knowledge, and experience of dining facility managers in the handling of frozen meat and in the planning and scheduling of food preparations. Some managers properly prepared frozen meat for tempering by removing the meat from cartons and separating the pieces onto racks to facilitate tempering. Others did not because of lack of experience, knowledge, planning, or other reasons. Some managers with restricted refrigeration

TABLE 1

TEMPERING CAPABILITY OF DINING FACILITIES

SURVEYED UNDER EXISTING OPERATING MODE

No.	Seating Capacity	Refrigeration Capacity(cu ft)	Meals Served Per Day	Ratio of Cu ft/Meal/Day
33	96	195	450	* 0.4
15	270	1410	2000	* 0.7
8	68	154	170	0.8
3	80	240	300	0.8
21	100	965	1200	* 0.8
32	60	405	450	* 0.9
23	250	1819	2000	0.9
27	86	855	825	* 1.0
31	200	1520	1500	* 1.0
2	350	2700	2700	* 1.0
19	172	637	600	* 1.1
17	270	1422	1200	1.2
10	244	1550	1200	* 1.3
11	244	1550	1200	* 1.3
9	96	760	550	1.4
12	480	2740	2000	1.4
4	520	2960	2100	1.4
7	144	1164	750	1.6
6	75	775	450	1.7
5	201	2540	1500	1.7
1	264	1533	900	1.7
20	120	570	225	1.8
13	300	1484	800	1.9
14	300	1484	800	1.9
26	96	920	450	2.0
22	250	2000	1000	2.0
30	500	3675	1800	2.0
29	188	1265	600	2.1
16	270	1341	650	2.1
25	400	4020	1200	2.3
18	150	1400	600	2.4
28	80	947	325	2.9
24	400	3925	1200	* 3.3

* Dining facilities indicating pronounced tempering problems.

capacity minimized the problem by carefully controlling ration ordering and inventory. Other managers with adequate refrigeration space experienced tempering problems because of inefficient use of available equipment. There were indications during the survey that some managers order and store extra quantities of frozen meats to compensate for tempering problems associated with unanticipated increases in meal demand. This system is helpful for those facilities with adequate refrigeration space, but increases the problem with those facilities having marginal refrigeration space. Some managers plan, schedule, and anticipate ration requirements better than others. Lack of preplanning and good scheduling has a negative impact on the tempering of frozen meats. Good management practices will help to minimize but not eliminate ambient temperature tempering of meat.

3. Unanticipated Time Constraints

It is important to point out that, at times, dining hall managers are forced to resort to other than prescribed procedures for tempering even under the best of conditions, because of (a) time constraints due to out of stock items or late delivery by the TISA, (b) unanticipated and uncontrollable increases in meal demand, (c) conflict between Food Service Regulation AR 30-1[7] and Sanitary Regulation AR 40-5 (i.e., stockage allowed by former often does not allow sufficient tempering time under conditions prescribed by the latter), (d) lack of adequate sink space to temper by use of potable running water, and (e) lack of steam-jacketed kettles in which certain frozen meats can be cooked from the frozen state.

IV. MEAT ITEMS AND QUANTITIES REQUIRING TEMPERING

The average total amount of meat required to serve 1,000 troops per day is 1,142 lbs of which 468 lbs is considered to require tempering. The issue weight of meat required to feed 1,000 troops per day was calculated from the 42-day menu. From this information the quantities requiring tempering were determined. These data are provided in Table 2. The unit of 1,000 troops is used as a base because it can be easily factored, and straight line projections can be derived for any other feeding population. This information can be used as a guide to plan facilities and/or equipment and determine the cost effectiveness of the most efficient system to handle frozen meats requiring tempering.

V. ALTERNATIVE TEMPERING SYSTEMS

A subjective analysis was made to evaluate and predict what benefits and/or problems would result if alternative systems (e.g., controlled temperature or microwave energy) for tempering

[7] AR 30-1, 1977. Food Program - The Army Food Service Program. Headquarters, Department of the Army, Washington, D.C.

TABLE 2

TOTAL MEAT ITEMS AND FROZEN QUANTITIES REQUIRING TEMPERING
TO FEED 1,000 TROOPS PER DAY FROM THE 42-DAY MENU

Meat Item	Ingredient Weight Per 1,000 Troops	Tempering Not Required	Tempering Required
	lb	lb	lb
Bacon Sliced	4110	4110	
Beef Corned	1437	1437	
Beef Diced	1350		1350
Beef Ground	4160		4160
Beef Grilled Steak	1760		1760
Beef Liver	260	260	
Beef Oven Roast	1330		1330*
Beef Patties	9263	9263	
Beef Swiss Steak	1140		1140
Beef Pot Roast	2460	2460	
Bratwurst	505	505	
Bologna	180		180
Chicken Cut-Up	2750		2750
Frankfurts	1560	1560	
Fish Portions	690	690	
Fish Fillets	540		540
Fish Sticks	220	220	
Ham Cooked	1050	1050	
Ham Canned	2017	2017	
Italian Sausage	540	540	
Knockwurst	260	260	
Lamb Chops	180		180
Lamb Roasts	190		190*
Oysters	100		100
Pork Sausage	1060	1060	
Pork Butt	540		540
Pork Spareribs	1480		1480
Pork Slices	640		640
Pork Ham Boneless	920		920
Pork Roast Boneless	640		640*
Pastromi	105		105*
Polish Sausage	260	260	
Salmon Canned	100	100	
Salami	60		60
Shrimp Raw Breaded	370	370	
Turkey Boneless Raw	1130	1130	
Turkey Boneless Cooked	1048		1048
Tuna Canned	280	280	
Thuringer	40		40
Veal Cutlets Breaded	720	720	
Veal Ground	300		300
Veal Roast	200		200*
TOTAL 42 Days	47945	28292	19653
Per Day	1142	674	468

*Items usable tempered or not tempered

frozen meats were performed at the TISA and dining facility levels and handled under current TISA and dining facility concepts of operation.

A. Controlled Temperature

1. Troop Issue Support Activity Level

Controlled temperature tempering of frozen meats at the TISA would require construction of tempering rooms. If this were accomplished within the facility it would intensify existing space constraints. Increased planning, scheduling, and labor would be required because standard installation menus are not used and a multiplicity of ration items would have to be handled as a result of the diversity of menus in use. The time required to temper meats is an important factor. The average frozen meat container weighs 50 to 60 lb. To temper this quantity within the carton could take from 2 to 5 days depending on conditions of tempering. Uniform tempering would be difficult to achieve. AR 40-5 restricts tempering of meat at 40°F (4.4°C) for no longer than 72 hours. By the time this meat is delivered to the dining facility and used, it could be marginal with or even in excess of AR 40-5 requirements. If product were removed from the container to facilitate tempering, handling and labor costs would increase. Close control would be required to repackage the same product in the right container to assure that container information for issue weight and nomenclature, etc. properly represented the contents. It is believed that controlled temperature tempering at the TISA would be impractical, cumbersome, not cost-effective, and potentially marginal with respect to compliance with AR 40-5.

2. Dining Facility Level

Controlled temperature tempering at the dining facility is the recommended procedure in AR 40-5. Compliance to the regulatory requirement for controlled air temperature tempering is frequently not achievable at the dining facility level for reasons given in the discussion on Dining Facilities (para III-B). To improve the current system, rapid-thaw refrigerators could be used. These units are capable of rapidly thawing frozen meats in a sustained controlled temperature range of 40°F (4.4°C) by use of a dual thermostatic control of refrigeration and heat cycles and a high rate of air circulation. These units are simple to operate and maintain, and will provide safe tempering within a 12 to 24 hour period instead of the nearly 48 hours now required by refrigeration units in many dining facilities. Appendix A contains specific information for this equipment.

The regulations also allow controlled temperature tempering to be accomplished with potable running water at 70°F (21.1°C) or less. The use of water tempering, although recommended by AR 40-5, is not used to the extent it could be because of the limitation that it "....may be used only if the product is sealed in original

container....". This seems contradictory and unnecessary. Most frozen boxed meat items procured by the military are not in sealed containers and some have no inner containers. The necessity for sealed containers for some items is questionable. Kitchen personnel should be allowed to package and seal frozen items in new plastic bags when required to increase the use of water tempering. This method is more expedient and safer than uncontrolled air temperature tempering because of the reduced exposure time to hazardous temperatures.

B. Microwave Tempering

1. Troop Issue Support Activity Level

Microwave tempering is fast, efficient, and its use would overcome those problems associated with controlled temperature tempering at the TISA as described above. Microwave batch tempering of frozen meat is used by commercial processors and the advantages claimed by the manufacturer are:

a. Allows flexibility because tempering is done only as required.

b. Allows predictable ending temperature with controlled temperature rise. This enables further handling to be carried out under optimum conditions of product temperature.

c. Eliminates need for tempering rooms or tempering racks and saves space and handling.

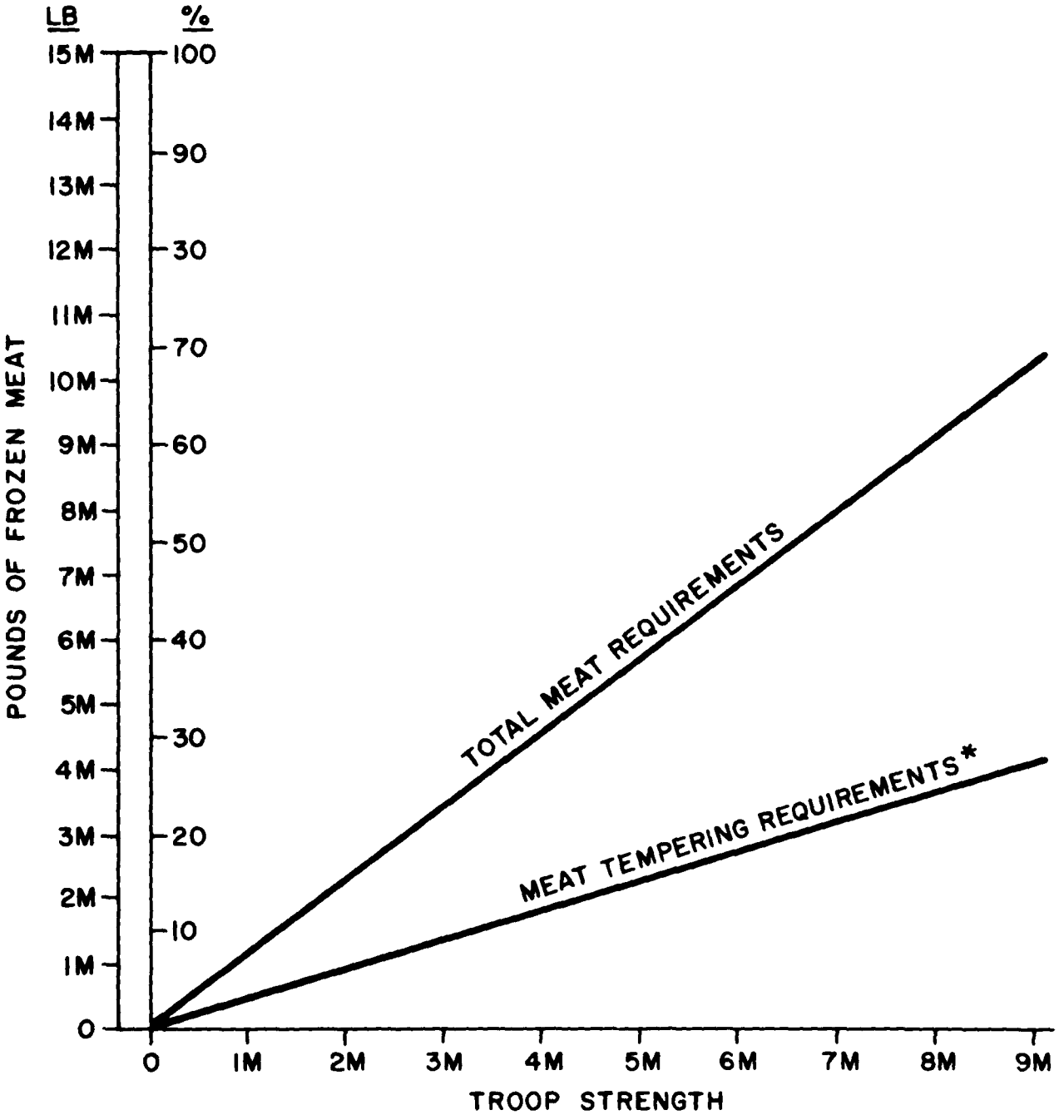
d. Improves sanitation and saves labor in stripping cartons, since tempering takes place in carton and there is no bacterial growth during tempering.

e. Improves quality and yield. Since there is no drip loss, protein and flavor compounds are retained.

f. Simplifies compliance with sanitation and temperature control regulations and guidelines.

At the present time there is only one domestic industrial size batch microwave tempering unit on the market suitable for use at the TISA. The unit is a Raytheon Co., Model QMP 1879. Appendix B provides specific information on this equipment. The estimated cost to procure, ship, and setup a new unit at a site in the continental United States is estimated at $80,000.

The throughput of this batch processing is approximately 15,000 lb per 8-hour shift. This throughput rate, when compared to daily tempering requirements at the TISA, indicates that such a large unit may not be required for the majority of installations. Figure 1 shows the average daily total meat requirements and frozen meats requiring tempering for various troop feeding levels versus rated capacity of the QMP 1879 unit. Based on current feeding data



* INCLUDES ITEMS USABLE TEMPERED OR NOT TEMPERED.

FIGURE 1

RAYTHEON QMP-1879 MICROWAVE TEMPERING UNIT CAPACITY VERSUS MEAT TEMPERING REQUIREMENTS PER 8-HOUR DAY FOR VARIOUS TROOP STRENGTHS

provided for dining facilities in operation (Feb 1979),* no Army installation would use more than 25% of the rated capacity of the QMP 1879 tempering unit. If a sufficient military requirement for a smaller unit develops, industry could make the capital investment to develop and produce the units.

In addition to proper location and installation for a microwave tempering unit, trained operating and maintenance personnel will be required. Proper operation of the unit will be required to prevent hot spots, melt-back and cooked product; proper maintenance will prevent unit breakdown and radiation hazards to personnel; routine tests will assure compliance with necessary standards and controls IAW Army Regulation 40-44.[8] A contingency plan will be required to assure continuity of operation in the event of equipment failure. Microwave tempering will change the handling and delivering of meats. Refrigerated vans will be required.

2. Dining Facility Level

Microwave tempering at the dining facility level would overcome tempering problems associated with current dining hall practices. The advantages and operational requirements for its use are similar to those listed earlier for the TISA level. Its use would provide the dining facility manager with greater flexibility to temper meat and handle unanticipated increases in meal demand. The logistics problems associated with its use at the TISA level would be eliminated. At the present time all domestic commercial institutional size systems operate on very high frequency (2450 MHz), short waves that are more effective for heating and cooking than tempering. Because this frequency has low penetrating ability, defrosting occurs first at the periphery. Because water absorbs microwave energy 25 times greater than ice, meats to be tempered under this system may require intermittent applications of energy to equilibrate the product to prevent hot spots and/or overheating. Should microwave tempering prove effective and feasible for use at the dining facility level, the units could serve a dual function by being used as a standard microwave oven to heat and cook foods. Appendix C contains specific information on a typical institutional size unit.

VI. PUBLIC HEALTH ASPECTS OF MEAT TEMPERING

As indicated earlier in this report, the practice of ambient temperature tempering of meats occurs frequently and creates a potential health hazard. An actual health hazard will occur only

* Data provided by Troop Support Agency, Ft. Lee, VA

[8] AR 40-44, 1977. Control of Potential Hazards from Microwave Cooking Ovens and Other Microwave/Radio Frequency (RF) Food Service Devices. Headquarters, Department of the Army, Washington, D.C.

if the meat surfaces are exposed to time and temperature conditions that will allow proliferation of pathogenic microorganisms or organisms that develop enterotoxins and if subsequent cooking is inadequate to destroy these organisms or heat stable toxins. If all the undesirable conditions are present, a foodborne disease outbreak will occur. A survey was conducted to determine the history of such occurrences for the installations surveyed in this study. Information received from these installations indicates that the occurrence of foodborne disease attributable to improper meat tempering practices in dining facilities is negligible. However, the potential for a food poisoning outbreak to occur when meat is improperly tempered remains a viable threat. This threat will remain until conditions that create the threat are controlled.

One alternative to control the problem would be to eliminate deficiencies in the current system by improvements as discussed in para V A-2. Another would be to consider the use of microwave energy for the tempering of meats at the TISA or at the dining facility level. Microwave tempering at the TISA would present a unique situation unlike that to be found in an industrial application. The advantages claimed for industrial applications of the process may not hold true under the unique military situation. Based on current TISA and dining facility concepts of operations and practices noted during the study, the potential exists for creating a new set of sanitation problems. The potential for these problems exist because a more perishable product will be issued, transported, and stored at the dining facility for 24 to 72 hours (96 hours on holiday weekends). Tempered meat will tolerate less temperature abuse than that which occurs during transport/delivery and during refrigeration failures. At installations surveyed, most units that pick up rations would have to replace their nonrefrigerated trucks with refrigerated trucks, or alternatively, all tempered meats would have to be delivered by the TISA in refrigerated vans. Use of tempered meat by TO&E units for field feeding could be a major cause for concern, because nonrefrigerated trucks are used for delivery, and field refrigeration is limited. All of these potential sanitation and perishability problems will be accentuated at the more southerly located installations, where adequate delivery van temperatures are difficult to maintain and all refrigeration equipment is under greater stress. Microwave tempering at the dining facility, from the standpoint of sanitation, would overcome those problems associated with its use at the TISA and allow better control. Extensive testing of microwave energy tempering under the military situation, is required before the sanitary benefits or new sanitary problems that might result from its use can be fully determined.

VII. RECOMMENDATIONS

AR 40-5 states that potentially hazardous raw frozen food should be cooked from the frozen state. From the microbiological point of view, this is the ideal situation, but it is not always compatible with all methods of food preparation. The longer a food item remains frozen prior to preparation and cooking, the longer effective control of microbiological hazards and spoilage is

maintained. To retain this effective control, proper procedures for the tempering of frozen meats must be employed.

A. TISA Facility Level

Recommendations for application of tempering at the TISA level are as follows:

1. Eliminate controlled air temperature tempering from further consideration. It is impractical and not cost-effective.

2. Test microwave energy tempering under military conditions to accurately determine the benefits and/or problems that would result from its use. It is recommended that the test unit be acquired by mating the microwave transmitter located at Fort Lee with a new QMP batch applicator. The estimated cost to do this, including shipping and setting up at a test site, is $41,700.

B. Dining Facility Level

Ambient temperature tempering of meats at the dining facility level is a potential health hazard that should not be tolerated. Conditions, equipment, and procedures should be available to assure that tempering can be accomplished in compliance with Army regulations. Recommendations to accomplish this objective are as follows:

1. Modify package configurations of items having bulk or package configuration that impede even rate of tempering, i.e., layer pack cut-up chicken instead of bagging or boxing; shape and bag bulk ground beef into a thin rectangular instead of a cylindrical unit. As a result, time to temper would be substantially reduced, regardless of the method used.

2. Increase refrigeration space, where required, to assure at least 1.5 cu ft of refrigeration per meal per day. The survey data indicate that tempering problems are greatest when less than 1.5 cu ft of refrigeration space per meal is available.

3. Test rapid-thaw refrigerator units to determine their adaptability, efficiency and cost effectiveness as a tempering system to replace refrigeration cabinets.

4. Test microwave oven units to determine their adaptability, efficiency, and cost effectiveness as a tempering system.

5. Modify current regulatory requirements to allow an increase in the practice of tempering with potable running water.

6. Large RTC poultry presents a special problem. Conduct tests to determine the safety and effectiveness of rapidly tempering unpackaged poultry in potable running water in a manner that allows free access of water to the body cavity.

7. Upgrade the cook's scholastic program and provide refresher courses in the field. Intensive training in the basic principles of food microbiology and sanitation would effectively improve the present system. The eventual benefit of this recommendation is to have key personnel in the kitchen better able to understand and cope with problems of food protection, safety, and sanitation.

C. Parameters for a Test Program

It is recommended that a test program to evaluate current versus alternative methods for handling the meat requirements of the dining facilities be structured on a systems approach to obtain data in the following areas:

1. Availability of tempering units
2. Operational effectiveness
3. Location of tempering system
4. Initial investments and operating cost
5. Energy efficiency
6. Quality, nutritional aspects, and yield
7. Degree of tempering required
8. Space, facility, and utility requirements
9. Microbiological and sanitation aspects
10. Comparative economic analysis

D. Other

Conduct a survey to evaluate and determine the extent and reasons for current field feeding problems in relation to distribution, available refrigeration, handling and preparation of meats, and the effect of utilizing tempered meats for field feeding.

VIII. CONCLUSIONS

Considerable evidence was obtained during the survey that frozen meats issued to the dining facility are frequently not handled according to procedures stated in Army regulations. Improper procedures or systems to temper meat can cause a health hazard and deleterious changes that result in loss of quality, nutritive value, and yield. It is recommended that improvements be made to existing procedures. Various other procedures and systems are available to make improvements, but require study to

determine the best procedure or system to reduce or eliminate sanitary problems, potential health hazards, and deteriorative changes in product quality that can occur under current TISA and dining facility concepts of operation.

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APPENDIX A

HOBART

FOOD EQUIPMENT

M, K & E SERIES REFRIGERATORS

SAFE-T-THAW® OPTION

WHAT IT IS

The Safe-T-Thaw option thaws frozen food under sustained refrigeration. It can be added at the factory to any two or three section Hobart Series M, K, or E medium temperature self-contained refrigerator.

WHAT IT DOES

It may do nothing, or a great deal, depending on whether there is need for it or not. Its primary function is the rapid thawing of frozen foods. When there is no thawing to be done, the cabinet operates as a standard Hobart refrigerator in all respects. Even during a thawing cycle, previously thawed foods are kept as cold as though they were in a standard Hobart refrigerator.

HOW IT DOES IT

A Safe-T-Thaw equipped refrigerator "fights" room temperature **and also** "fights" frozen food temperature. A refrigerator has one thermostat that calls for refrigeration to bring the temperature down to 40 when it rises. A Safe-T-Thaw has this, and it also has **another** thermostat that calls for mild heat to bring the temperature back **up** to 40 when frozen food causes it to fall. Frozen food may be put in at any time, even when thawed food is present, and thawed food may be put in or taken out at any time, because the basic principle is to keep the cabinet at 40 *regardless of room temperature or product load.* Technically, the system uses reverse cycle refrigeration, which means that refrigerant is used for both cooling and heating.

WHO DOES IT

Safe-T-Thaw does it, by itself, and completely automatically, since the system responds to any change in cabinet temperature, up or down. However, if uncovered foods are stored in the cabinet, it may be advisable to shut off the air circulation booster temporarily. There is a manual switch for this. Without the booster, the thawing rate is considerably slower and therefore the booster should be turned on again as soon as uncovered foods are either covered or removed.

WHEN IT DOES IT

Normally it works at night, but it will work equally well at any time. The simplest procedure is to load in bulk frozen food late in the day. Then, by first thing in the morning, the *food is thawed, cold, and ready to use.*

WHY IT DOES IT

Simple — to provide high return on owner's investment.

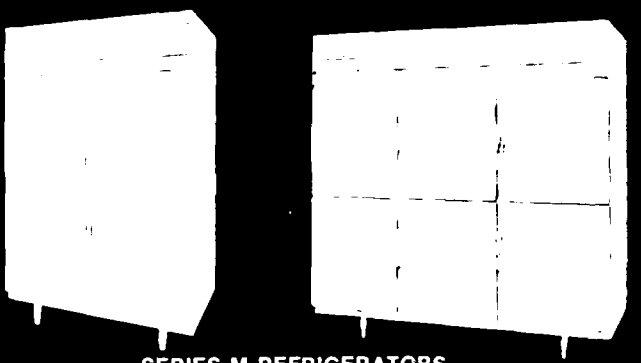
Safe-T-Thaw (1) makes planning easier and better because of short thawing time.
(2) meets full requirements of sanitarians and other public health people.
(3) holds food quality by allowing heating to be delayed until just before serving.
(4) permits 100% salvage of leftovers and keeps them at high quality.

See Typical Specification on Reverse Side.

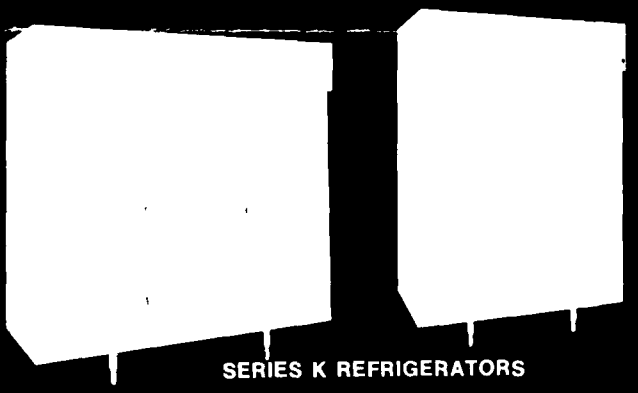
As continued product improvement is a policy of Hobart, specifications are subject to change without notice.

WORLD HEADQUARTERS
TROY, OHIO 45374

SAFE-T-THAW OPTION



SERIES M REFRIGERATORS



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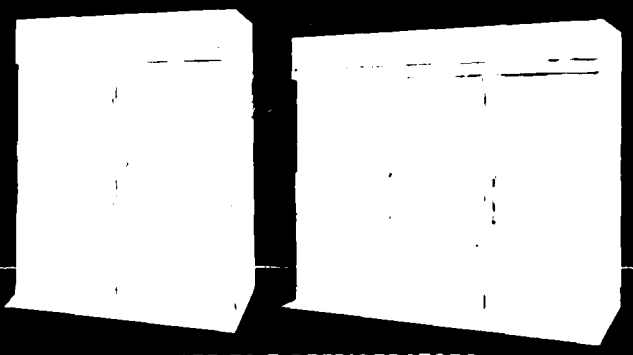
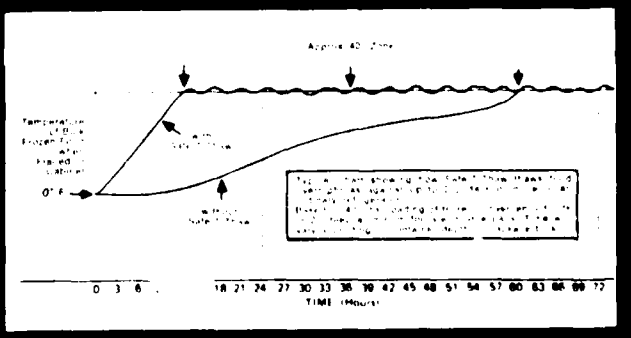


SERIES E REFRIGERATORS



TYPICAL SPECIFICATION FOR SAFE-T-THAW UNITS

Item _____ shall be Model No. { TM / TK / TE } (2,3 Section) (S or V) Safe-T-Thaw Refrigerator. Designed to accelerate the thawing of frozen product. Examples—(TM2S TKV2 TE2S).

It shall be manufactured by Hobart Corporation, and shall be listed as a Hobart model by Underwriters' Laboratories and National Sanitation Foundation. The cabinet shall have:

Minimum net storage capacity of ___ cubic feet. Maximum exterior dimensions, less legs, of____ high, _____wide, and_____deep. _____sections, with (½ or full length doors) per section.

(Apply the appropriate Hobart cabinet construction and mechanical description as shown on M,K or E Series specification sheets).

The Safe-T-Thaw system shall be actuated automatically by components which reverse the refrigeration cycle and raise the air temperature in the cabinet, as required by frozen product load. Interior mounted electric heating elements for this purpose are not acceptable.

Temperature sensing devices are to be adjusted for the "cut-in" of refrigerated air and at the 45° temperature level. In addition to the standard Hobart down duct air system, two (2) air circulating fans shall be installed behind each center door mullion, with manually operated switches to accelerate air movement during the thawing operation.

SAFE-T-THAW ELECTRICAL RATINGS

The TM and TK units are one step higher horsepower than the standard M's and K's. They all use the E series units plus the added fans.

The Specifications are:

MODELS	TK2, TM2, TE2		TK3, TM3, TE3	
SUPPLY VOLTAGE	115/60/1	115-230/60/1	115/60/1	115-230/60/1
COMPRESSOR H.P.	½	½	¾	¾
BTU/hr.	4340	4340	6200	6200
Watts	895	895	1450	1450
Amps	9.7	4.9	15.6	7.8
BASIC CABINET				
Watts	330	330	515	515
Amps	3.2	3.2	4.9	4.9
BOOSTER FANS				
Watts	175	175	350	350
Amps	1.7	1.7	3.4	3.4
MAXIMUM				
Watts	1400	1400	2315	2315
Amps	13.1	8.8	21.5	14.5

NSF

HOBART CORPORATION

HOBART SAFE-T-THAW COST AND CAPACITIES

Reach-In Type (Series M & K on information sheet)

Model No.	Capacity	GSA Price
HS-2 (2 section)	47.0 cu. ft.	$2,283
HS-3 (3 section)	72.9 cu. ft.	$3,073

Roll-Thru Type (Series E on information sheet)

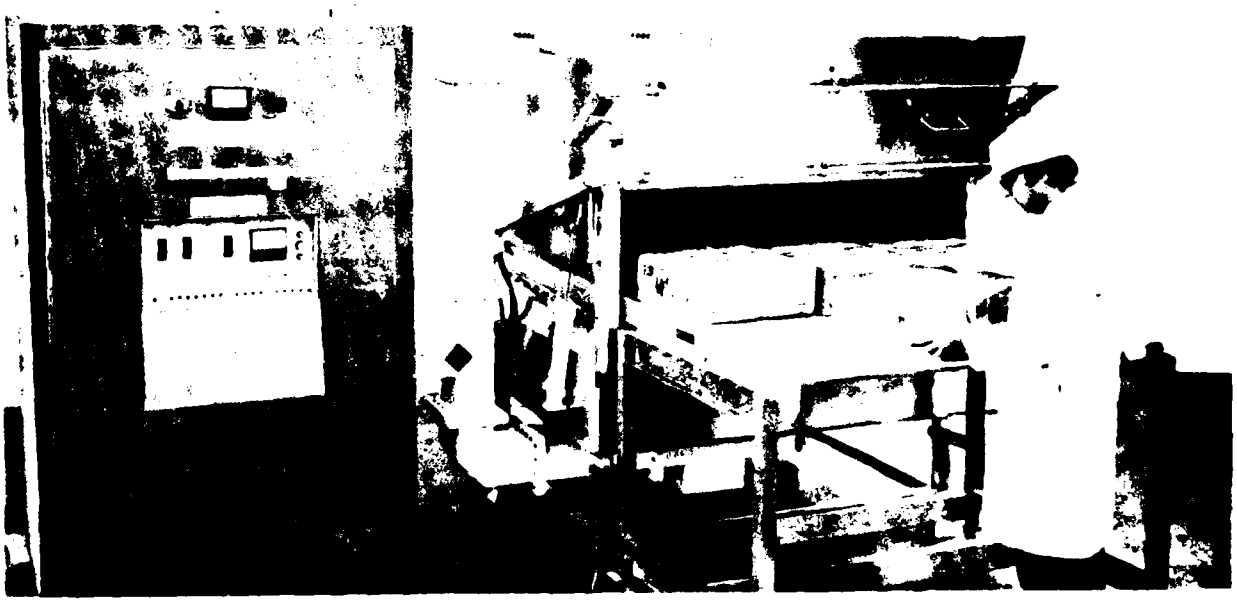
Model No.	Capacity	GSA Price
HESD-2 (2 section)	62.0 cu. ft.	$3,215
HESD-3 (3 section)	93.0 cu. ft.	$4,122

APPENDIX B

RadarLine®

QMP1879

Microwave Processing Equipment for the Food Industry



QMP1879 BATCH PROCESSOR

The QMP1879 Batch Processor is an industrial microwave oven designed for batch tempering of frozen meat, fish or poultry. It will temper from 5000 to 15,000 pounds of frozen meat per shift, making it ideal for portion-control plants, ground beef operations, sausage kitchens, and frozen prepared food manufacturing.

The RadarLine Processor will temper a typical load of about 300 pounds in ten minutes. The processing time can be varied to give precise control of temperature rise or temper. The oven's interior dimensions are 50" x 42". This enables a uniform loading procedure for the simultaneous processing of one tier of containers from a 40" x 48" pallet. The following table shows the time required to temper 300 pound loads of representative products from a 0°F starting temperature.

85% lean beef to 26°F	9 minutes
50% lean beef or pork to 22°F	5 minutes
poultry to 27°F	11 minutes
cod blocks to 22°F	6 minutes

The RadarLine Processor provides controlled tempering in a small fraction of the time required for conventional tempering. Consider these advantages:

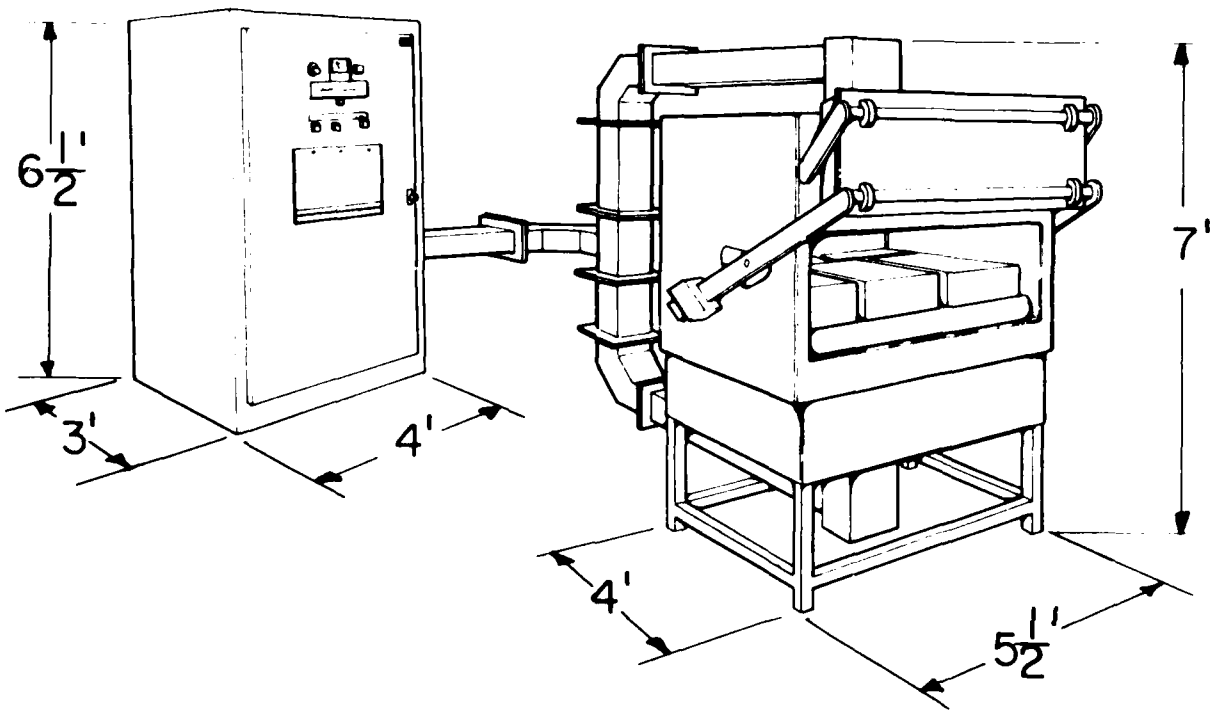
- Adds flexibility to processing because tempering is done only as required.
- Allows predictable ending temperature with controlled temperature rise. This enables further processing to be carried out under optimum conditions of product temperature or hardness.
- Eliminates the need for tempering rooms or racks, saves space and handling.
- Improves sanitation and saves labor stripping cartons, since tempering takes place in the carton. There is no bacterial growth during tempering.
- Improves quality and yield since there is no drip loss. Protein and flavor compounds are retained.
- Simplifies compliance with Government sanitation and temperature control regulations and guidelines.

RAYTHEON

Raytheon Company
Food Processing Equipment
Foundry Avenue, Waltham, Mass. 02154 (617) 899-8400 EXT. 4570

QMP1879
BATCH PROCESSOR

460 VOLTS, 3-PHASE, 60 CYCLE, 35 KVA
.9 POWER FACTOR
25 KW 915 MHz OUTPUT



The QMP1879 is a production machine designed to withstand the rigors of the food processing environment. All electronic circuitry is housed in a remote 25 kW transmitter that is built to withstand the typical temperature and humidity extremes found in food plants. This transmitter has been in use for years with the RadarLine Tunnel and provides outstanding reliability. The entire system is of stainless steel construction, and to facilitate cleaning, all corners are round and full accessibility to interior surfaces is provided. The QMP1879 is designed to comply with applicable regulations pertaining to personnel safety, sanitation, electric codes and electromagnetic interference.

RAYTHEON
Raytheon Company
Food Processing Equipment
Foundry Avenue, Waltham, Mass. 02154 (617) 899-8400 EXT. 4570

APPENDIX C

Menumaster® MICROWAVE OVEN

The Menumaster Systems 70/80 was designed to meet the needs of high volume restaurants and institutional food service operations. It delivers more power and has a larger cavity to heat large quantities of food – fast. It's perfect for steam-table supply, point of service, multiple plate and multi-container heating. This powerful oven was engineered for heavy duty defrosting and high volume.

FEATURES:

Electromechanical Dial/Solid State Pushbutton Combination Timer: Provides settings up to 21 minutes on dial and from 10 seconds to 21 minutes on 6 preset buttons.

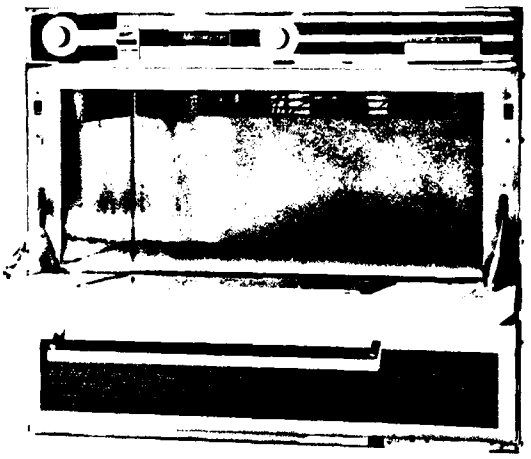
Large Stainless Steel Heating Cavity (24" x 14" x 10") Defrosts five pounds of frozen food in 6 minutes. Heats three 9-inch dinner plates in one minute forty seconds.

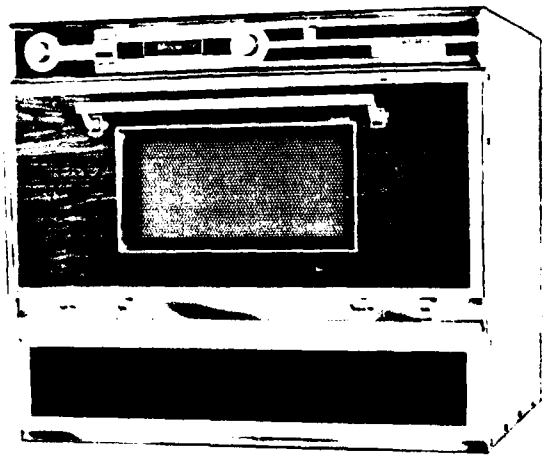
Intrusion-Proof, Cast Aluminum, See-Through Door with double glass protection, becomes convenient access shelf to oven cavity. Advanced technology in dual concealed interlocks.

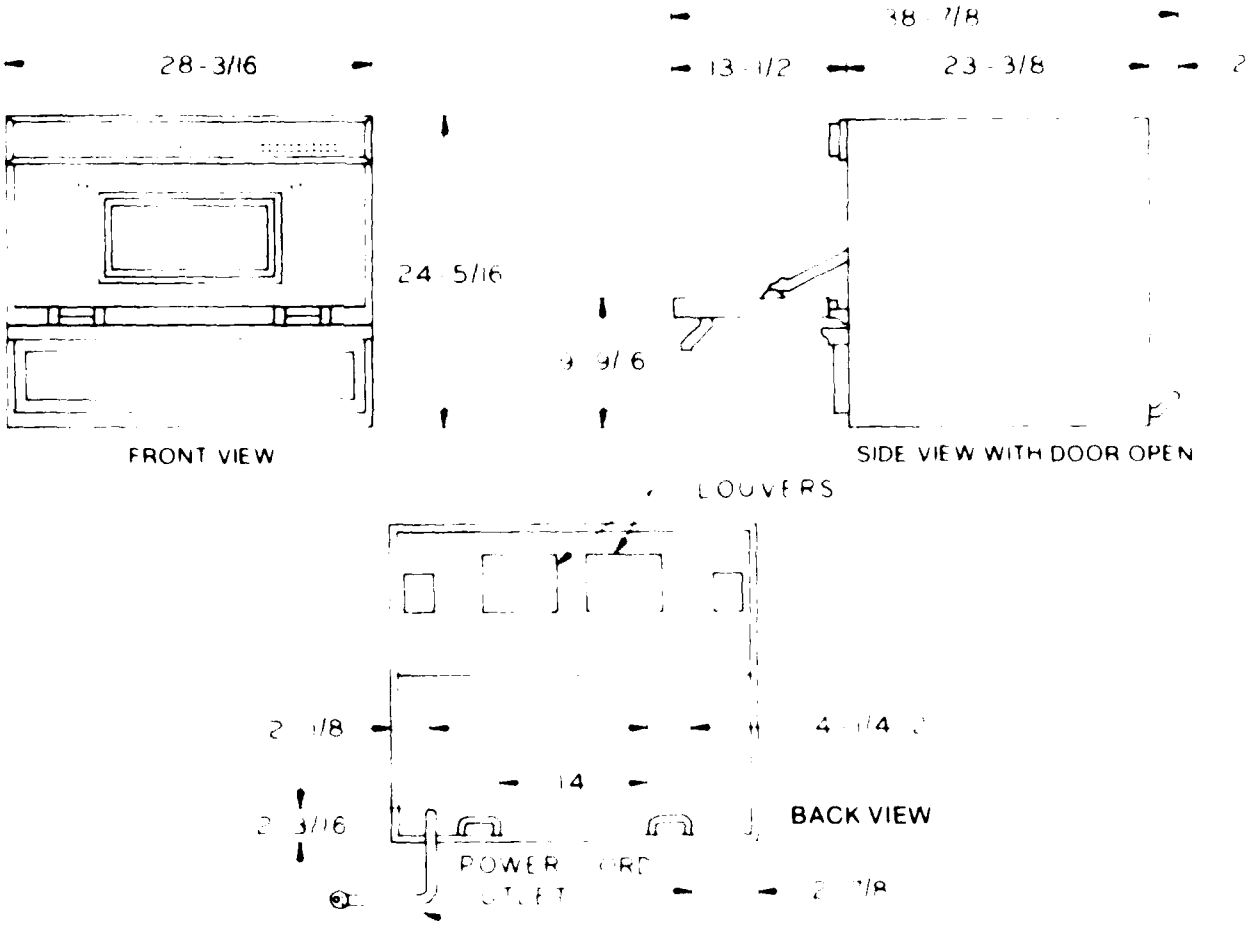
Attractive Styling with stainless steel wrap, walnut wood grain door.

Exclusive Licron™ Advanced Power Supply System has set the industry standard. Powered by two magnetrons specifically designed by Litton for heavy duty restaurant use. Oven can be operated with one or both magnetrons at full or reduced [illegible]. Automatic voltage regulation to assure constant power input. Ten-second warmup to ensure long magnetron life. Sixty-second automatic shutdown for protection of components, an economic use of energy. Constant speed blower system for proper cooling of electrical components. Wrap and timer interlock system which automatically shuts off all power within the oven when its outside wrap is removed for servicing.

Improved Serviceability: front slide out panel allows servicing of key components without removal of oven from location. Removable timer panel provides easy access for timer adjustments.







DIMENSIONS:

Cabinet: Width 28-3/16" Height 24-5/16". Depth 25-3/8" (allow 2" behind for air circulation)

Cavity: Width 24". Depth 14". Height 10" (usuable space)

ELECTRICAL SPECIFICATIONS:

Voltage: 208 to 240 volts AC 3 wire, single phase

Amps: 30 amp circuit 60 cycle

Wattage: Standby -0-
Idle 450 watts
Operating High Power, 5400 watts
Low Power, 2700 watts
Output High Power 2000 watts (at 220 volts)
Low Power 1000 watts (at 220 volts)

Frequency: 2450 Mhz

Power Cord: 6 foot 3 wire grounding type 30 amp UL rating. Viewing oven from rear, cord center is 2" from bottom and 2-3/16" from left side.

Receptacle: 30 amp 240 volt 3 wire receptacle required. (Receptacle furnished with oven)

Weight: Net 243 lbs. Shipping 285 lbs.

WARRANTY

12 months Guarantee against defective material or workmanship on all parts and associated labor. 24 additional months on magnetron replacement part cost only.

APPROVALS

Litton certifies that all microwave ovens of manufacture meet Federal safety Standards and are listed by the Underwriters Laboratories. In addition, each Litton commercial model meets standards as set forth by the National Sanitation Foundation, the Canadian Standards Association, and the Federal Communications Commission.

TO SPECIFY A LITTON 70/80 COMMERCIAL MICROWAVE OVEN

Oven shall be certified to have been designed and tested for [illegible] performance standard for microwave ovens. Electrical controls for oven shall [illegible] automatic 60 second shutdown. Oven shall be of stainless steel [illegible] pattern. Cavity shall be illuminated. Air filter and timer panel shall be [illegible] proof, see through window and shall have two independent sealing systems [illegible] interlocks. Oven shall meet standards. Rated at [illegible] year shall include all parts and labor. 24 additional months guarantee on magnetron [illegible]

For information or location of nearest authorized service agent, call **800-328-7777** (toll free in Canada) **416-677-7051**